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The Epidemiology, Control and Prevention of Dengue Hemorrhagic Fever (DHF) in Indonesia

Sumarmo Poorwo SOEDARMO

Professor and Head, National Institute of Health Research and Development, Ministry of Health, Indonesia.

Abstract: Dengue Hemorrhagic Fever (DHF) is one of the eight communicable diseases which cause high mortality in children in Indonesia. Since the first outbreak in 1968, incidence rate of DHF has been significantly increasing. The highest number of DHF cases is reported in 1988, with 47,573 cases mostly from the island of Java. DHF is also spreading from 2 regencies in 1968 to 187 regencies in 1992 throughout all the 27 provinces in Indonesia. The Case Fatality Rate (CFR) of DHF in hospital has been gradually decreasing from 41.3% in 1968 to 2.9% in 1992. The number of DHF cases increases mostly during the rainy season (November-January).

Since 1976, all of the four Dengue serotypes have been isolated from patients clinically diagnosed as DHF. Dengue-3 and Dengue-2 are interchangeable the dominant serotypes.

Aedes aegypti, as the main vector, is found to be wide spread both in houses as well as in public places with House Index in 7 cities decreasing from 36% in 1986 to 28% in 1992.

Control and prevention of DHF is based on community participation through village cadres to eliminate breeding places all year around, mass fogging before the expected transmission season, fogging focus in the DHF premises and surrounding places.

The future trend of DHF, 1993-1998 is predicted to have the same Incidence Rate, decrease of CFR, due to improvement of water supply, community participation, early diagnosis and treatment and development of probable Dengue vaccine.

Health Status in Indonesia

Based on National Household Survey, the mortality proportion of infectious diseases in Indonesia declines from 71.7% in 1980, to 58.6% in 1985 and to 49.2% in 1992. Diarrheal and immunizable diseases primarily contributed to the decrease of mortality proportion, while acute respiratory infection/pneumonia, tuberculosis and malaria contributed to its increaase.

Percentage of mortality proportion caused by non-infectious diseases increases from 28.3% in 1980 to 41.4% in 1985 and to 51.8% in 1992. This increase was due to cardiovascular diseases and injury.

Dengue Hemorrhagic Fever (DHF) is one of the eight highest mortality proportions of all ages. The eight highest mortality proportion on infectious diseases are follows:

ARI/pneumonia, diarrheal diseases, tuberculosis, tetanus, infectious hepatitis, diphtheria/pertusis/measles, malaria and Dengue Hemorrhagic Fever (DHF). The mortality proportion of DHF is increased during the last decade, from 0.8% in 1980 to 1.2% in 1985. The trend of DHF proportion of mortality in 1992 cannot be calculated.

In areas where drinking water is very scarce, inadequate storage of clean water, or inadequate drainage of surface water provides a lot of breeding places for mosquitoes. It is estimated that to this date about 38% of the rural population in Indonesia has access to protected water supplies, while 62% hasn't. In the urban areas, it is estimated that about 40% of the population has access to piped water system and the remaining 60% hasn't. The low proportion of households which has access to drinking water will also contribute to the increase of breeding places.

Epidemiology of DHF

DHF was reported for the first time in 1968 from an outbreak in Surabaya and Jakarta. Since then, the Incidence Rate (IR) of DHF has been increased with cyclic epidemic patterns in every five years (Figure 1). Started in 1968, incidence rate of DHF per 100,000 population has been increased from 0.08, to 8.14 in 1973, to 4.96 in 1978, to 8.65 in 1983 and the highest being 27.98 in 1988 with a total number of DHF cases 47,573 (Figure 1). During the last four years (1989-1992) the average incidence rate of DHF was 9.79 with a total number of DHF cases between 10,362 to 22,807 DHF cases every year.

Aside from the high incidence rate, the Case Fatality Rate (CFR) of DHF has been gradually declining from 41.3% in 1968 to 4.6% in 1973 and 2.9% in 1992 (Table 1). This

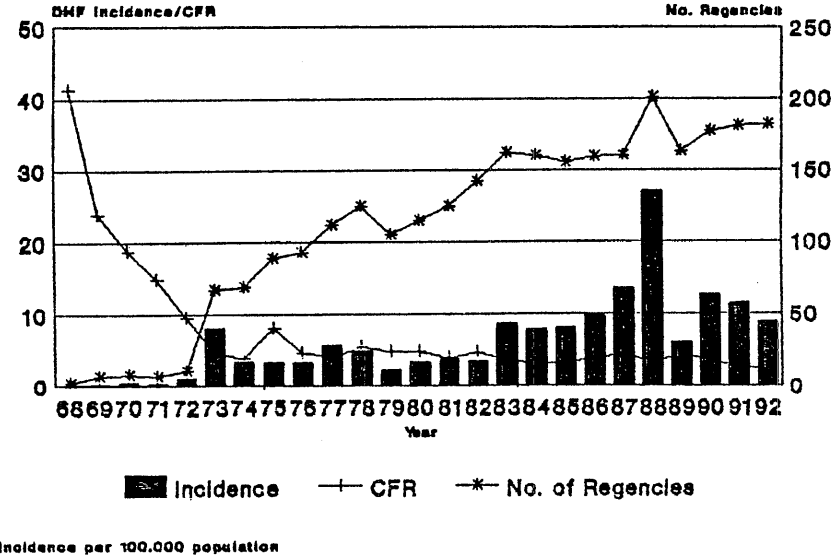

Fig. 1. DHF incidence, CFR and number of regencies affected in Indonesia, 1968-1992

is due to the increase of skills in diagnosing and treatment of DHF and the contribution of a training program by the government for the doctors, nurses in hospitals and Primary Health Care Centres throughout Indonesia, so that treatment services in hospitals have become more and more successful in handling DHF cases.

During the first decade, DHF has spread through big cities mainly on the island of

Table 1. Number of DHF cases and deaths in Indonesia 1968-1993*

Year	DHF Cases	DHF deaths	Case Fatality rate (%)	Incidence rate (100,000 population)	Provinces affected	Regencies/ Municipalities affected
1968	58	24	41.3	0.05	2	2
1969	167	40	23.9	0.14	2	7
1970	477	90	18.8	0.4	4	8
1971	267	40	14.9	0.22	3	7
1972	1,400	135	9.6	1.14	4	11
1973	10,189	470	4.6	8.14	10	67
1974	4,586	180	3.9	3.57	10	69
1975	4,563	368	8.1	3.47	19	89
1976	4,548	214	4.7	3.38	19	93
1977	7,826	320	4.1	5.69	16	112
1978	6,989	384	5.5	4.96	20	125
1979	3,422	165	4.8	2.37	23	105
1980	5,007	243	4.8	3.39	23	115
1981	5,978	231	3.9	3.96	24	125
1982	5,451	255	4.7	3.53	22	142
1983	13,668	491	3.6	8.65	22	162
1984	12,710	382	3.0	7.86	20	160
1985	13,588	460	3.4	8.14	19	155
1986	16,529	608	3.7	9.79	23	159
1987	23,864	1105	4.6	13.5	20	160
1988	47,573	1527	3.2	27.98	25	201
1989	10,362	464	4.5	6.09	24	163
1990	22,807	821	3.6	12.70	21	177
1991	21,120	578	2.7	11.56	24	181
1992	17,620	509	2.9	9.45	24	187
1993*	7,392	171	2.3		25	164

*) Up to July 1993.

Jave, the most densely populated island in Indonesia. Consecutively, DHF starts to infest rural isolated areas and also other islands.

The number of Regencies/Municipalities affected by DHF has increased from 2 in 1968 to 187 in 1992 (Figure 1). For the objectives of DHF control and prevention, Indonesia is divided into several endemic areas according to the differences of DHF incidence rate per 100,000 population as shown in Figure 2. Starting from this year DHF is already reported from all over 27 provinces in Indonesia.

For the past 3 years (1991-July 1993), the most affected provinces with high incidence rate of DHF were: Jakarta (42.1), Yogya (37.1), East Jave (21.0), Central Java (14.4), West Java (9.4), North Sulawesi (12.6), South Kalimantan (8.1) and East Kalimantan (8.4), (Table 2).

Age Proportion of DHF in the period of 1968-1973, 1980, 1984-1989 and 1990-1992 is shown in Figure 3. The percentage of DHF cases in the less than 1 year old age group was decreased from 3.1% to 0.8%; in the 1-4 years old age group it had decreased from 40.4% to 14.1%, in the 5-14 years old age group it was almost constant with an average of 55% and in the more than 15 years old age group had increased from 4.3% to 25.4%. The shift to the older age group phenomena remains to be duly explained. A recent serological study in Yogyakarta shows that 98% of children aged 1-3 years old has had antibody to Dengue. This high positivity rate has never been found in the past.

The fluctuation of DHF cases every year depends on seasonal variation (Figure 4). The Number of DHF cases usually increases during the rainy season, starting from September to February with peaks in January.

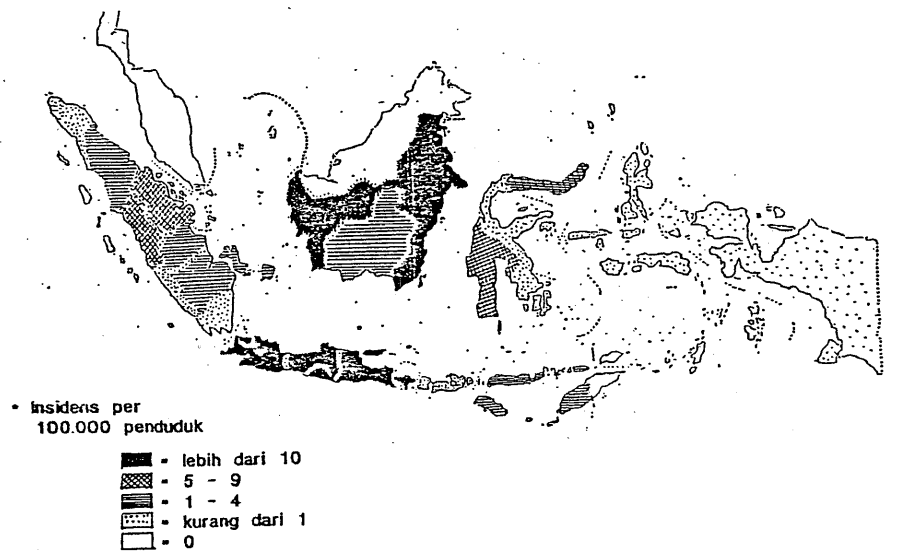

Fig. 2. Average annually DHF incidence rate (1988-1992) by province in Indonesia

Review of Dengue virus isolation from hospitalized cases from several hospitals is shown in Table 3. All four Dengue serotypes have been isolated since 1975 from mild as well as severe cases with shock, hemorrhagic manifestation and death. In 17 years, the

Table 2. Number of DHF cases and deaths in Indonesia by province, 1991-1993*

Province	1991			1992			1993	
	DHF cases	DHF deaths	IR**	DHF cases	DHF deaths	IR**	DHF cases	DHF deaths
Dista Aceh	26	6	0.27	32	5	0.89	25	1
North Sumatera	47	4	0.45	195	11	1.83	156	4
West Sumatera	196	0	4.82	129	0	3.11	72	0
Riau	75	1	2.19	212	6	6.08	55	3
Jambi	30	2	1.44	103	2	4.85	30	1
South Sumatera	98	7	1.51	208	11	3.15	50	4
Bengkulu	1	0	0.08	9	0	0.72	1	1
Lampung	17	1	0.28	24	2	0.38	35	3
DKI Jakarta	3,547	46	42.12	4,377	42	50.97	1,017	9
West Java	3,438	134	9.47	2,950	128	7.97	1,366	42
Central Java	4,181	85	14.49	4,388	145	14.91	2,161	38
DI Yogyakarta	1,088	24	37.14	729	19	24.40	237	6
East Java	6,929	192	21.10	3,023	85	9.03	1,450	26
West Kalimantan	97	11	2.92	115	16	3.39	89	6
Central Kalimantan	24	1	1.66	17	1	1.15	50	0
South Kalimantan	216	2	8.13	81	3	2.99	25	0
East Kalimantan	166	8	8.48	89	2	4.46	7	0
North Sulawesi	318	16	12.63	183	7	7.13	25	4
Central Sulawesi	0	0	0.00	10	0	0.56	9	0
South Sulawesi	519	31	7.33	272	6	3.77	107	6
South-east Sulawesi	0	0	0.00	0	0	0.00	2	0
Bali	80	3	2.85	353	8	12.32	211	5
West Nusa Tenggara	4	0	0.12	13	1	0.37	9	0
East Nusa Tenggara	11	1	0.33	107	9	3.15	200	12
Maluku	12	3	0.63	0	0	0.00	0	0
Irian Jaya	0	0	0.00	1	0	0.06	0	0
East Timor	0	0	0.00	0	0	0.00	3	0
Total	21,120	578	11.56	17,620	509	9.45	7,392	171

*) Up to July 1993
**) IR = Incidence Rate per 100,000 population

dominant serotypes is either Dengue-3 or Dengue-2 with the average proportion of 46.06% and 31.47% consecutively. In 1981, there was an epidemic of DHF in rural area Bantul, which was caused mainly by Dengue-3, much less by Dengue-1 and Dengue-4, and none by Dengue-2. These two Dengue serotypes are also considered the most severe strains of Dengue in Indonesia. Dengue-1 and Dengue-4 are isolated at the average of 18.35% and

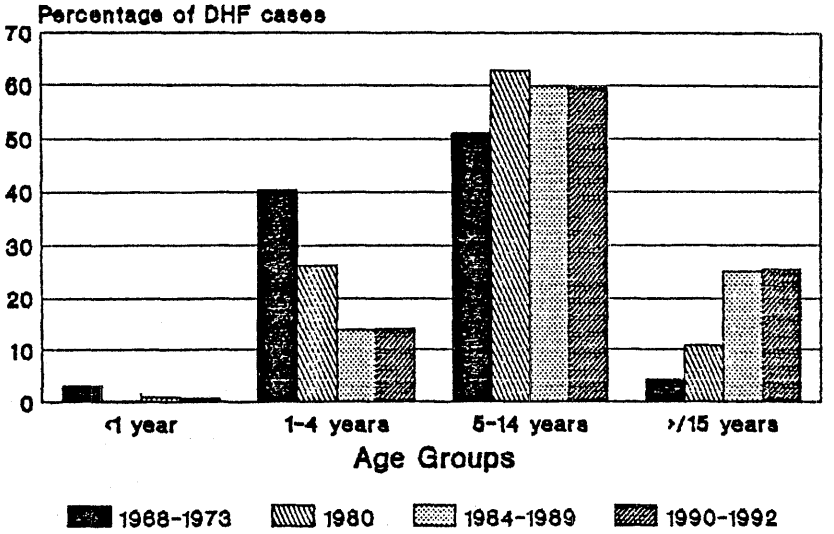

Fig. 3. Age proportion of DHF cases in Indonesia 1968-1992

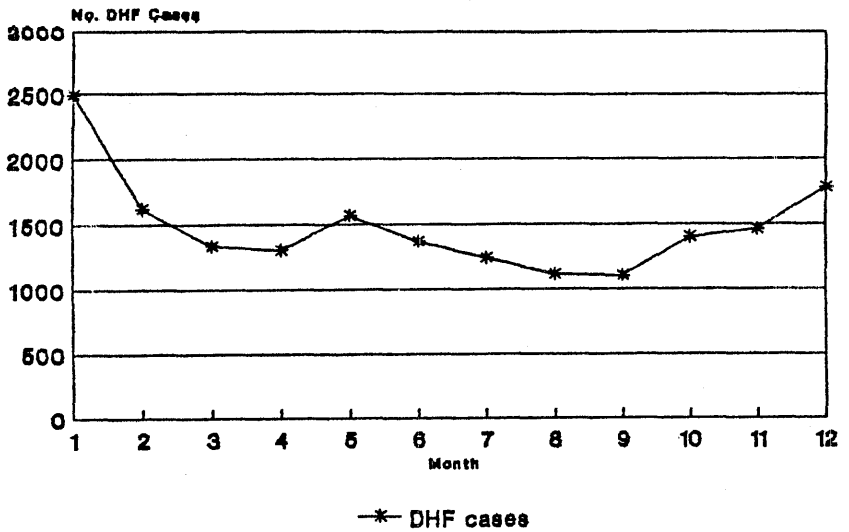

Fig. 4. Average annual number of DHF by month in Indonesia, 1988-1992

Table 3. Isolation of dengue virus from DHF patients in Indonesia, 1975-1992

Year	Dengue serotypes				total
	Dengue-1 No. (%)	Dengue-2 No. (%)	Dengue-3 No. (%)	Dengue-4 No. (%)	
1975	4 (44)	3 (33)	2 (23)	— (0)	9
1976	18 (7)	21 (19)	54 (50)	15 (14)	108
1977	10 (11)	20 (22)	56 (59)	9 (8)	95
1978	7 (15)	21 (46)	18 (39)	— (0)	46
1979	5 (13)	18 (46)	14 (36)	2 (5)	39
1980	6 (14)	15 (34)	22 (50)	1 (2)	44
1981	9 (17)	14 (32)	29 (67)	2 (4)	54
1982	7 (15)	20 (42)	21 (43)	— (0)	48
1983	5 (12)	17 (41)	16 (39)	3 (8)	41
1984	4 (11)	12 (34)	18 (51)	1 (4)	35
1985	3 (12)	10 (38)	13 (50)	— (0)	26
1986	17 (18)	33 (35)	39 (43)	4 (4)	93
1987	11 (12)	17 (20)	53 (61)	6 (7)	87
1988	9 (16)	12 (21)	32 (57)	3 (6)	56
1989	1 (10)	2 (20)	7 (70)	— (0)	10
1990	48 (40)	30 (25)	33 (28)	9 (7)	120
1991	5 (45)	3 (27)	2 (17)	1 (1)	11
1992*	9	8	9	7	33

* Up to September 1992
1975-1988 Data from NHIRD
1988-1992 Data from NAMRU-2, Jakarta.

4.12% of DHF cases in hospitals.

Aedes aegypti is the main vector of DHF, while *Aedes albopictus* is considered another potential vector. The distribution of *Ae. aegypti* has been reported in all 27 provinces. In Irian Jaya, *Ae. egypti and Ae. albopictus* were found in 9 airports as well as sea ports, i. e. Jayapura, Biak, Sorong, Manokwari and Merauke. The average house index was 2.6 and the range was from 0.3-9.8 in 1968. The Directorate General for CDC & EH (1992) reported that *Ae. aegypti* indices were found at residential and public places in 83 cities in 1991/1992. The premise indices at the residential areas in 19 cities were less than 5, and in 33 cities more than 5. The indices at the public places in 24 cities were less than 5 and in 19 cities more than 5. There were 26 cities of which the indices at the temporary solid wastes collection were less then 5 and 10 cities of which indices at the water containers were more than 5. Such indices indicated that *Ae. aegypti*, the main vector of DHF, has spread out from the low to the high residential areas in all provinces

in the country.

Surveys on *Ae. aegypti* indices have been taken in 9 cities and towns from 1986-1987 and shown in Table 4 and Table 5. *Ae. aegypti* was widely found in household water reservoirs. The *Ae. aegypti* average premise index has no significant differences in houses, schools, offices, religious places, even in health facilities and in other public places ranging from 27 to 44. The highest container index of *Ae. aegypti* was found in watertanks (53.8). The other important breeding places were drums (36.5), water jars (31.7), container for bathing/toilets (20.5), discarded materials (27.5) and tree holes/bamboo stems (18.7).

Prevention and Control of DHF

The objectives of DHF Control Program are:

1. Reduction of DHF incidence rate in endemic subdistricts to less than 10 per 10,000

Table 4. Houses and public facilities with *A. aegypti* larvae in nine cities and towns in Indonesia, 1986-1987

	Number of Premise Examined	Premise with larvae	Premise index	Range of PI	Average PI
			(percentage)		
Houses	3,333	1,183	35.5	16.8−60.8	35
Schools	560	225	40.2	26.8−65.9	44
Offices	224	57	25.5	10.7−79.0	27
Religious places	186	48	25.8	10.5−47.0	28
Health facilities	108	43	39.8	16.7−70.0	39
Other public facilities	614	161	26.2	21.0−51.9	30

Table 5. Types of water containers which acted as *A. aegypti* breeding sites in nine cities and towns in Indonesia, 1986-1987

Water containers	*Number of containers* Examined	With larvae	Container Index (Percentage)
Containers for bathing/toilets	2,976	611	20.5
Water jars	3,000	951	31.7
Drums	1,472	538	36.5
Water tanks	93	50	53.8
Pails and others	320	26	8.1
Containers for drinking of birds	512	46	9.0
Tree holes/ bamboo stem	273	51	18.7
Discarded materials	1,393	383	27.5
Flower vases	580	37	6.4
Total	10,619	2,693	25.4

population

2. Reduction of CFR of DHF to less than 2.5%
3. Increase community participation so that the Free *Ae. aegypti* Larvae Rate of houses in endemic subdistrict will be more than 95% or house index less than 5%.

Activities on DHF prevention and control will consist of :

1). Early warning system by early case detection through epidemiological investigation of FUO (Fever of Unknown Origin) and larvae indices in the hospitalized DHF cases' houses and 20 nearby premises. Fogging Focus supported by source reduction of *Ae. aegypti* breeding sites by the community in the confirmed DHF cases' houses and nearby premises at 100 m distance.
2). Intensive Control Program in endemic subdistricts which consist of : (a) Massive Fogging, two cycles with one week interval, before the predicted seasonal increase of transmission supported by selective larvaciding every 3 months in endemic villages; (b) Elimination of *Ae. aegypti* breeding sites through community participation in all villages in the endemic subdistricts; and (c) Selective Larvaciding is also conducted every 3 months in all schools, hospitals, health centers, and other public facilities in the endemic subdistricts.
3). Health Education Campaign through village cadres, village working groups, peer groups, leaflets, pamphlets, films, etc.

For the time being, the success of DHF control program only depend on the success in vector, *Ae. aegypti*, control. Subdirectorate of DHF Control has conducted several approaches in vector control; the latest one is what is called Intensive Vector Control Program. This program defines an endemic subdistrict as a subdistrict which has at least one endemic village. A village where DHF occurs every year during the last three years is called endemic village. Appropriate Intensive Vector Control Program is a program which conducts massive fogging in endemic villages, and regular larvae inspection based on house to house visits every 3 months in all villages of the endemic subdistrict. In endemic villages temephos larvaciding is applied in water containers found with larvae (selective larvaciding).

To support DHF control program, Research and Development (R & D) activities have been conducted to evaluate impacts of clinical treatment and diagnosis, community participation, program policies, transmission reduction contributed to adulticide and larvacide etc. Special Working Groups for R & D on DHF were established 5 years ago. This group consisted of various specialist in the field of Clinics, Public Health, Epidemiology, Sociology, Anthropology, Virology from Universities, Government and NGO which work together based on multicentres cooperation approach throughout Indonesia.

Community participation on elimination of *Ae. aegypti* breeding places is reflected in the special larva surveys from 7 cities and town in Indonesia in 5-6 years apart (Table 6). A slow decrease of indices is observed in public places (5%), and faster decrease is achieved by schools (11%) and houses (8%).

Budget expenditure by Sub. Dit. Arbovirusis, Dit. Gen. CDC & EH for control and prevention of DHF in Indonesia, 1979-1992 is shown in Figure 5. from 1979 to 1984. The average budget expended was below one billion rupiah (500 thousands US $). Started from 1988 budget has increased from 1 billion rupiah to 11 billion rupiah in 1992 (5 millions US $), more than 10 times of increase within 4 years period. The increase of budget expenditure is statistically not related to the decrease of DHF incidence rate, because the Correlation Coefficient using log 10 between budget and incidence rate is 0.0818. Coverage of intensive control program in 1991/1992 is still under the total targeted areas. The coverage of prevention and control measures at districts level is only 65.2%, subdistricts level is only 34% and villages level is only 26%.

Future Trend of DHF in 1993-1998

The trend of DHF will follow the whole Health Development Trend in the country.

Table 6. Results of survey of *Aedes aegypti* in 7 cities and towns in Indonesia 1986/1987 and 1992.

Location	Premise/House Index		Differences
	1986/1987	1992	
Houses	38%	30%	− 8%
Schools	43%	32%	−11%
Public places	28%	23%	− 5%

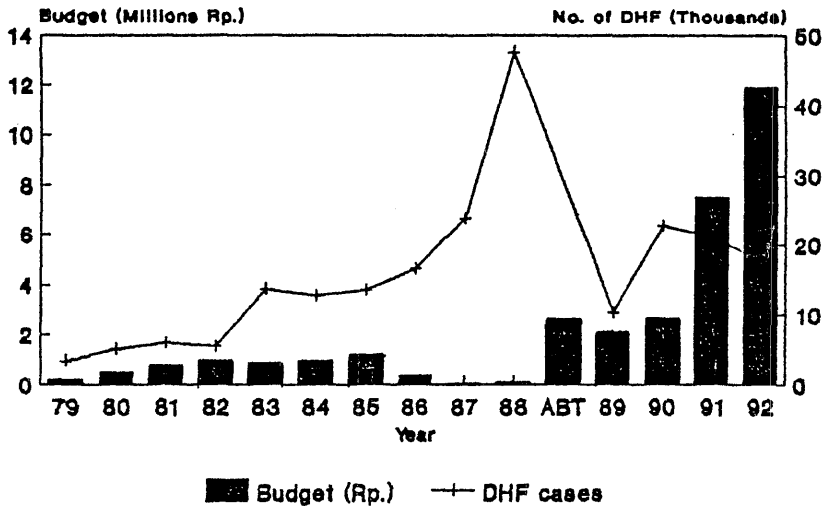

Fig. 5. Budget expenditure for dengue control and number of DHF patient

Some determinant factors which contribute to health development are:

- Economic development will continue at a much faster rate and will certainly increase household income and prosperity. It will then increase private participation in the health development.
- Mobility rate of people will increase
- Income earners will come and stay in big cities which creates urbanization problems and increase environmental contamination with disease agents.

One of the important factors which influence DHF incidence is the magnitude of environmental contamination in form of *Ae. aegypti* infestation in the man-made breeding places. This environmental contamination could be referred as the significance factor for transmission of Dengue virus.

Personal illness control according to Mosley will be able to increase individual preventive measures to avoid diseases by eliminating environmental infestation. But many public health professionals are often faced with the problems of the tendency of the community to revert to former patterns of behavior after initial enthusiastic reception to the new innovation wear off.

For the next five years, 1993-1998, the favorable factors on DHF trend analysis are: improvement of water supply, increase of community participation on reduction of mosquitoes breeding places, improvement of early diagnosing and treatment and the development of possible Dengue vaccine. While the unfavorable factors are: increase of urbanization problems, questions on pathogenesis and the determinant factors of 5 years cyclic of DHF epidemic.

Based on the above proximate determinants it is predicted that DHF trend are as follows: the incidence rate will increase and fluctuating, but CFR of DHF will decrease.

Expenditure for supporting DHF control and prevention programs are generally low. Therefore, in allocating the limited budget for DHF control and prevention attention needs to be concentrated on making a few simple but effective health technologies widely accessible. Mechanism for private and community financing to support DHF control and prevention activities should be further developed.

At last, the promotion of community participation including the private sectors, professional and non-government organization which is carried out through the enhancement of intersectorally supported communication, information and education (IEC) should be maximally explored.

REFERENCES

1) Suharyono W. (1986): Sepuluh tahun pengamatan virus Dengue di Indonesia 1975-1985. Symposium on Dengue Hemorrhagic Fever, Jakarta 26 July 1986.

2) Sumarmo (1989): Demam Berdarah Dengue di Indonesia, Situasi sekarang dan harapan dimasa mendatang, Semiloka Berbagai Aspek Demam Berdarah Dengue dan Penanggulangannya, Depok 27–28 Nopember 1989.

3) Sumarmo, S. Wuryadi, W. Gubler (1986): Clinical observation on hospitalized patients with virologically confirmed dengue hemorrhagic fever in Jakarta, Indonesia, 1975−1983, Paediatr. Indon. 26: 137.

4) Imran L. (1990): Children and adult DHF cases in Jakarta, Indonesia, 1988, Dengue Newsletter Vol 15, February 1990.

5) Suroso T., A. Abdulkadir A., DHF Epidemiological Situation in Indonesia, (unpublished).

6) CBS,NFPCB, Min. of Health (1992): Demographic and Health Survey 1991, October 1992.

7) NIHRD, Min. of Health (1993): The Trend Assessment of Health Development in Indonesia, June 1933.

8) IPHA (1993): Analysis of the Health Transition in Indonesia, Implication for Health Policy.

9) Mosley W. H., Chen L. C. (1984): Child Survival, Strategies for Research, Cambridge University Press.